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Agricultural Memorandum No 993

A COMPARISON OF ON-SITE OBSERVATIONS OF T-SUMS WITH VALUES INTERPOLATED FROM SYNOPTIC WEATHER DATA

1. INTRODUCTION

During January, February and March 1983 the Meteorological Office used synoptic weather data to calculate T-Sums. The calculated values were disseminated weekly in the form of maps giving T-Sum at mean sea level and an altitude correction in each of 190 grid squares covering England, Scotland and Wales.

The maps were used to estimate T-Sums at 12 sites in South West England and Wales and the estimates have been compared with on-site observations.

2. CALCULATION OF T-SUM FROM MEASUREMENTS ON SITE

The daily increment to T-Sum is ½ (maximum temperature + minimum temperature) if this value is greater than zero, otherwise the increment is zero. T-Sum is the total of all daily increments from 1 January.

The sites chosen for this comparison are observing stations at which daily recordings of maximum and minimum temperatures are made under standard conditions. Bastreet, Exton, Lyneham, Plymouth and Rhoose are synoptic stations and their observations were used in the preparation of the T-Sum maps so they do not give a fully independent check but the remaining 7 stations sent data to the Meteorological Office after the maps were issued and, therefore, allow an independent assessment of the system.

3. ESTIMATION OF SITE VALUES FROM A T-SUM MAP

Figure 1 is a copy of the T-Sum map for 15 February 1983. The upper number in each square is the T-Sum at mean sea level at the centre of the grid square. The number below is the altitude correction and the number in the lower left corner is the square identifier.

The estimated site value of T-Sum is given by:-

$$\text{Sea level value} - \frac{\text{altitude correction} \times \text{site altitude in metres}}{100}$$

This is illustrated by the calculation for Hawkridge which is near the centre of square 166 at 314 m above sea level.

Estimated T-Sum at Hawkridge = $272 - 24 \times 314/100 = 197$

Not all site estimates of T-Sum are quite as simple as that for Hawkridge because not every site is near the centre of a square and there are sometimes large differences between values in adjacent squares. Large differences between squares occur mainly near the coast eg between sq 132 and sq 133 in figure 1. Figure 2 which is a map of mean daily temperature at sea level in January shows that large differences between adjacent squares are an inevitable consequence of temperature gradients near the coast in winter. For a site near the edge or corner of a square linear interpolation between surrounding values gives a better estimate of the sea level value appropriate to the site than T-Sum for any individual square. When interpolating grid square values it should be remembered that they represent

the centre of the square, even when that is in the sea. Having obtained an estimate of the mean sea level T-Sum for a site it must be corrected to the site altitude as in the Hawkridge example.

4. RESULTS AND DISCUSSION

The weekly values of estimated and observed T-Sum are shown in Table 1a for SW England and Table 1b for Wales. The date that T-200 was reached was calculated from both the estimated and observed weekly values by linear interpolation.

Generally the estimated T-Sums are slightly higher than the observed values even at synoptic stations whose data were used in the preparation of the maps, but the errors are small and of no practical significance except possibly at Moel Cynnedd and Rhoose.

The errors in T-Sum estimates for a particular site must be expected to increase with the distance of the site from synoptic stations and with the altitude difference between the site and the surrounding synoptic stations. Moel Cynnedd represents a severe test of the system being more than 50 km distant and 150 m higher than the nearest synoptic weather station. The error of 24 day-degrees on 1 March when the estimated T-Sum reached 200 at Moel Cynnedd is equivalent to an error of about 0.6°C in average temperature. This is only slightly worse than the error at Rhoose which was about 0.5°C at T-200. All other stations had insignificant errors.

5. CONCLUSIONS

For most sites T-Sum estimates obtained from Meteorological Office maps are satisfactory and would not be significantly improved by on-site measurements.

At remote sites at high altitude (more than 350 m) and sites with steep slopes to the North or South careful daily measurements with accurate thermometers in a good well exposed screen would be significantly better than the estimates.

Any comments or suggestions on this paper should be sent to the author.

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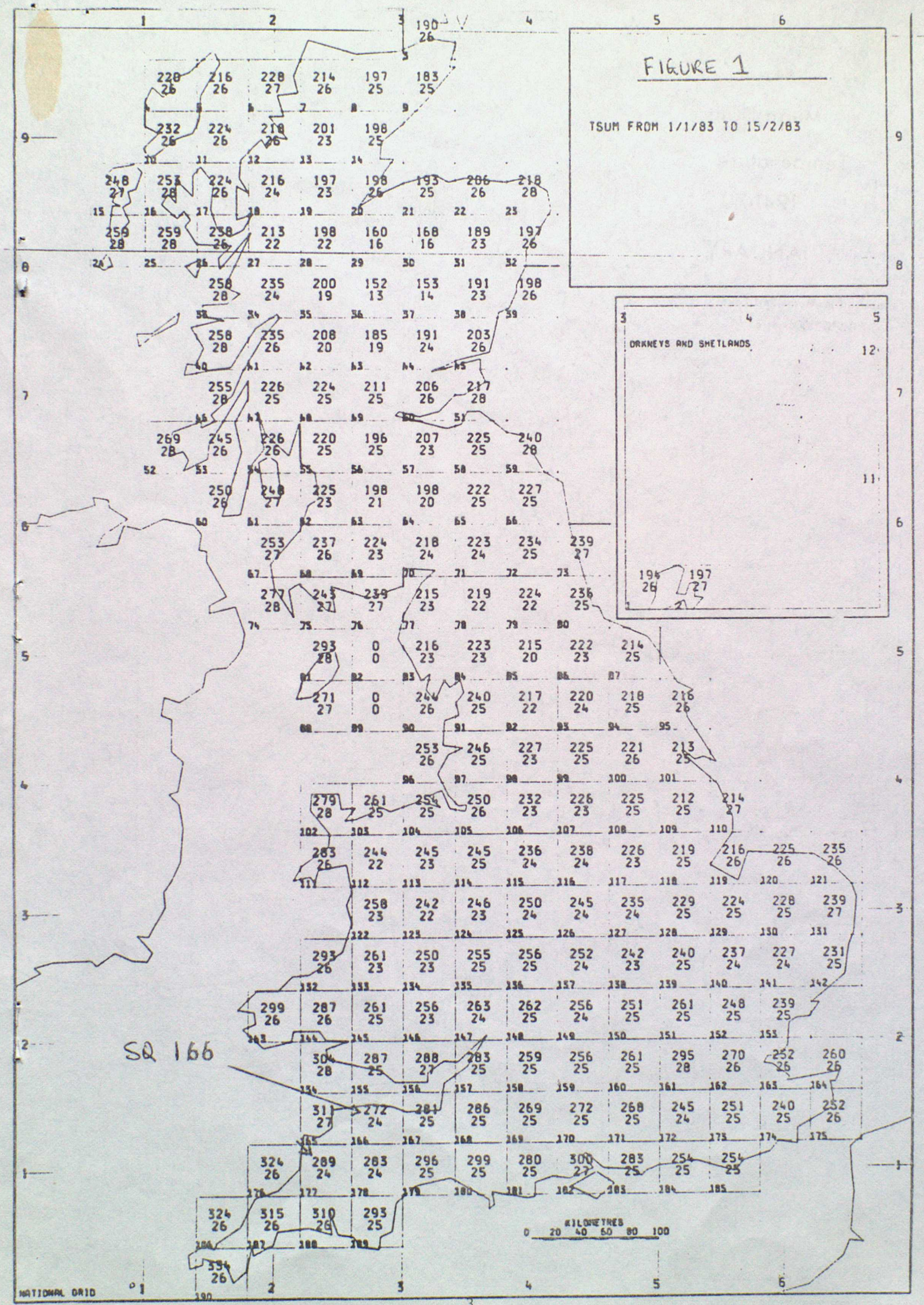


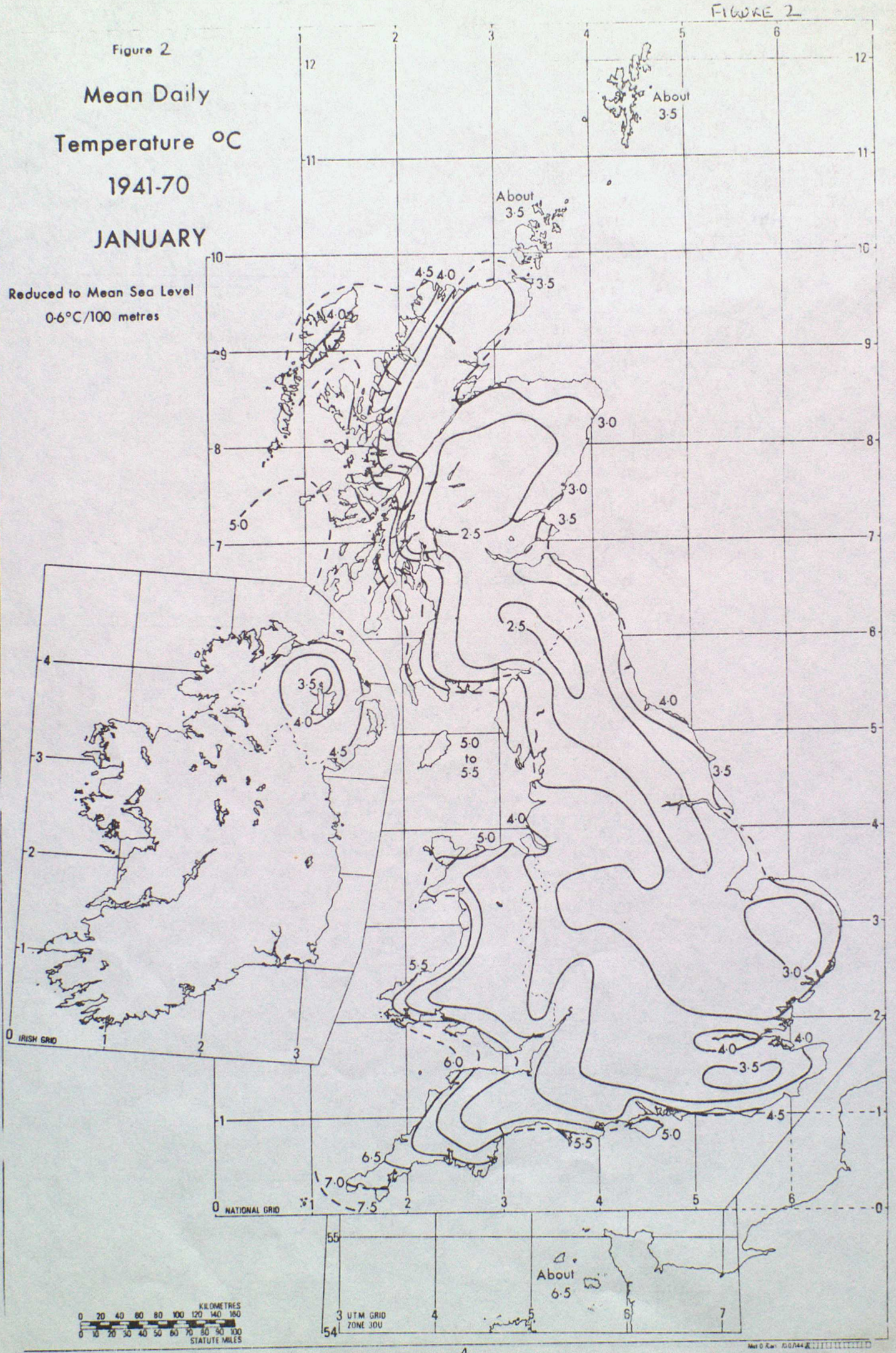
FIGURE 1
TSUM FROM 1/1/83 TO 15/2/83
ORKNEYS AND SHETLANDS
SQ 166
KILOMETRES
0 20 40 60 80 100
NATIONAL GRID

FIGURE 2

Figure 2

Mean Daily Temperature °C 1941-70 JANUARY

Reduced to Mean Sea Level
0·6°C/100 metres



T-SUM DATA FOR SOUTH WEST ENGLAND 1983

STATION	BASTREET		EXTON		HAWKRIDGE		LYNEHAM		NETTLECOMBE (BIRDS HILL)		PLYMOUTH		WESTBURY-ON-TRYM	
ALTITUDE	236 m		329 m		314 m		145 m		280 m		27 m		69 m	
	E	O	E	O	E	O	E	O	E	O	E	O	E	O
DATE														
4 JAN	31	30	27	24	26	26	31	30	29	31	37	34	34	35
11 JAN	80	78	69	66	70	69	80	79	75	79	100	98	90	94
18 JAN	127	126	109	105	109	110	129	126	119	122	159	157	144	151
25 JAN	162	158	136	130	139	138	161	156	149	148	204	199	185	189
1 FEB	209	204	178	167	180	182	206	199	194	190	264	257	237	239
8 FEB	233	226	195	180	199	197	222	215	213	204	298	295	263	264
15 FEB	233	226	193*	180	197*	197	223	216	211*	204	303	301	266	265
22 FEB	240	238	193	181	197	197	222*	217	210*	204				
1 MAR			222	208	197	199								
DATE T-200 REACHED	JAN 28	JAN 29	FEB 24	FEB 27	FEB 23	FEB 22	JAN 31	FEB 1	FEB 3	FEB 6	JAN 24	JAN 25	JAN 27	JAN 27

E - values estimated from maps

O - values calculated from on-site observations

* - T-Sum can only increase or remain the same but rounding errors in calculation and application of the altitude correction can produce a decrease in the estimated values.

T-SUM DATA FOR WALES - 1983

STATION	CWMYSTWYTH		LLANGENNY		MOEL CYNNEDD		RHOOSE		TRAWSGOED	
ALTITUDE	301 m		122 m		358 m		67 m		61 m	
	E	O	E	O	E	O	E	O	E	O
DATE										
4 JAN	26	26	31	34	27	26	33	33	33	33
11 JAN	66	66	81	87	64	62	89	87	83	83
18 JAN	101	101	127	138	104	96	142	137	132	133
25 JAN	130	129	160	158	128	117	183	172	172	168
1 FEB	175	168	206	207	163	150	234	219	220	217
8 FEB	190	182	228	224	174	157	263	242	245	240
15 FEB	192	184	228	226	176	157	269	244	247	241
22 FEB	193	186	229	231	177	157	279	251	253	256
1 MAR	219	210			199	175				
8 MAR					234	206				
DATE T-200 REACHED	FEB 24	FEB 26	JAN 31	JAN 31	MAR 1	MAR 7	JAN 27	JAN 30	JAN 30	JAN 30